

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listing, of claims in the application:

Listing of Claims:

1-16. (Canceled)

17. (Currently Amended): A flight simulator system for training pilots under wake vortex danger conditions, comprising:

a module (1) for control of the simulator modes is capable of choosing a training scenario and controlling operation of a plurality of simulator modules;

a training scenarios database module (2);

a module (3) for commutation of the simulator modules;

a module (4) for imitation of an outside visual situation, a visual part of the air space and a ground surface in real time;

a module (6) for simulation of a pilot workplace;

a module (5) for simulation of an aviation instrument panel with an indication of a plurality of aircraft engine modes;

a module (8) for simulation of a plurality of controls for a plurality of aircraft units and systems;

a module (7) for simulation of a plurality of ambient parameters;

a module (9) for simulation of a wake vortex situation caused by an aircraft is capable of determining a vortex generator wake vortex path as a set of the vorticity region centers and

intensity on the basis of information from the training scenarios database module (2) and information from the module (7) for simulation of the ambient parameters;

a module (10) for simulation of wake vortex perturbation effects on the aircraft is capable of evaluation of any aircraft additional forces and moments induced by the vortex generator wake vortices on the basis of information on the wake vortex path and intensity received from the module (9) for simulation of the wake vortex situation, information on the aircraft parameters received from the training scenarios database module (2), and information on aircraft position, flight velocity, angular rates, and geometrical characteristics received from a module (11) for simulation of the aircraft dynamics;

wherein the module (11) for simulation of the aircraft dynamics is capable of forming signals imitating the aircraft forces and moments according to the training scenario, as well as additional forces and moments induced by the vortex generator wake vortices, and transmitting the signals to the module (6) for simulation of the pilot workplace, module (5) for simulation of the aviation instrument panel, and module (4) for imitation of outside visual situation on the basis of information from the module (10) for simulation of wake vortex perturbation effects on the aircraft, from the training scenarios database module (2), and from the module (8) for simulation of the controls for the aircraft units and systems; and

a system for evaluation of the pilot actions is capable of estimating correctness of the pilot actions against the flight situation hazardous for the aircraft on the basis of information received from the module (4) for imitation of an outside visual situation and the module (5) for simulation of the instrument panel; and

a module of visualization including a visualization device is capable of forming the image at least of an area of the aircraft forecasted positions and wake vortex danger areas on the basis of information received from a warning module;

wherein the image of the area of the aircraft forecasted positions is represented by a first geometric shape;

wherein the image of the wake vortex danger areas is represented by a second geometric shape;

wherein when the first and second geometric shapes intersect, a warning is issued by the warning module.

18. (Previously Presented): The simulator as claimed in claim 17, wherein the module (6) for simulation of the pilot workplace is made with a possibility of changing its attitude and is equipped with a device for dynamic imitation of flight.

19. (Canceled)

20. (Previously Presented): The simulator as claimed in claim 17, further comprising a module for simulation of noise, optical and dynamic effects.

21. (Previously Presented): The simulator as claimed in claim 17, wherein the training scenarios are chosen from the group consisting of takeoff and landing at a ground airdrome, takeoff and landing at the aircraft carrier, individual and formation flight, flight refueling, and combinations thereof.

22. (Previously Presented): The simulator as claimed in claim 17, wherein it is implemented in software of the simulator modules of the operation of the simulator's modules and the module (7) for simulation of the danger area parameters includes a database of characteristics of wake vortex danger areas for different types of vortex generators.

23. (Canceled)

24. (Currently Amended): A flight simulator system for training pilots under the conditions when the pilots receive information on a forecasted possibility of an aircraft encounter with a vortex generator wake vortex danger area and additionally, the flight simulator system, comprising:

- a module (1) for control of the simulator modes is capable of choosing a training scenario and controlling operation of a plurality of simulator modules;

- a training scenarios database module (2);

- a module (3) for commutation of the simulator modules;

- a module (4) for imitation of an outside visual situation, visual part of the air space and ground surface in real time;

- a module (6) for simulation of the pilot workplace;

- a module (5) for simulation of an aviation instrument panel with an indication of a plurality of aircraft engine modes;

- a module (8) for simulation of a plurality of controls for a plurality of aircraft units and systems;

a module (7) for simulation of a plurality of ambient parameters;

a module (9) for simulation of a wake vortex situation caused by an aircraft is capable of determining a vortex generator wake vortex path as a set of the vorticity region centers and intensity on the basis of information from the training scenarios database module (2) and information from the module (7) for simulation of the ambient parameters;

a module (10) for simulation of wake vortex perturbation effects on the aircraft is capable of evaluation of [[any]] aircraft additional forces and moments induced by the vortex generator wake vortices on the basis of information on the wake vortex path and intensity received from the module (9) for simulation of the wake vortex situation, information on the aircraft parameters received from the training scenarios database module (2), and information on aircraft position, flight velocity, angular rates, and geometrical characteristics received from a module (11) for simulation of the aircraft dynamics;

wherein the module (11) for simulation of the aircraft dynamics is capable of forming signals imitating the aircraft forces and moments according to the training scenario, as well as additional forces and moments induced by the vortex generator wake vortices, and transmitting the signals to the module (6) for simulation of the pilot workplace, module (5) for simulation of the aviation instrument panel, and module (4) for imitation of outside visual situation on the basis of information from the module (10) for simulation of wake vortex perturbation effects on the aircraft, from the training scenarios database module (2), and from the module (8) for simulation of the controls for the aircraft units and systems;

a system for evaluation of pilot actions is capable of estimating correctness of the pilot actions against the flight situation hazardous for the aircraft on the basis of information received

from the module (4) for imitation of outside visual situation and the module (5) for simulation of the instrument panel;

a module (17) of parameters of the vortex perturbation danger area, comprising:

a unit (20) for evaluation of perturbation hazard is capable of estimating a perturbation hazard level at a given point according to a chosen hazard criteria for the aircraft additional aerodynamic forces and moments induced by the vortex perturbations on the basis of information received from the unit (16) for determination of the forces and moments, which belongs to the module (10) for simulation of wake vortex perturbation effects on the aircraft;

a unit (21) for determination of danger points where the additional forces and moments induced by the vortex perturbations are dangerous, the unit is capable of determining the coordinates of points belonging to the danger area according the hazard criteria based on information received from the unit (20) for evaluation of perturbation hazard;

a unit (22) for determination of a vortex perturbation danger area is capable of calculating the danger area geometrical characteristics on the basis of information received from the unit (21) for determination of danger points and transmitting the corresponding information; and

a warning module (18), comprising:

a unit (23) for selection of a delay time is capable of calculating the time period within which the aircraft has at least a possibility of a flight evasive maneuver providing evasion of the aircraft from the generator wake danger area after the signal warning against the possibility of wake encounter has been received;

a unit (24) for simulation of a control plane is capable of calculating the delay distance, which equals to the distance covered by the aircraft during the delay time, modeling the control plane situated in front of the aircraft perpendicular to its flight direction at the delay distance, and

determining the forecasted time necessary for the aircraft to gain the control plane in the inertial frame;

a forecasting unit (25) is capable of determining a generator wake path in the form of the set of the generator vorticity region centers with respect to the inertial frame and of the intensity of the generator wake vortices at the forecasted time on the basis of information from the unit for simulation of wake vortices in the module for simulation of vortex situation;

a unit (26) for calculation of intersection points is capable of determining the coordinates of the intersection points of the generator wake vortex trajectory and the control plane at the forecasted time of the aircraft flight through it;

an areas and regions forming unit (27) is capable of forming around an intersection point of the wake vortex path and the control plane of the wake vortex danger area in the form of the set of the generator vorticity danger areas, where the entering aircraft may have the flight parameters exceeding the admissible limits, forming in the control plane of the area of the aircraft forecasted positions at the forecasted time of the aircraft intersection with the control plane with due regard to the flight regulations, forming around the region of the aircraft forecasted positions of the alert area, the information on the entrance of the wake danger areas into the alert area will be provided to the user;

a transformation unit (28) is capable of calculating coordinates of the area of the aircraft forecasted positions, the alert area, and the wake vortex danger area in the aircraft frame;

a first intersection conditional test unit (29) is capable of calculating the distance from the alert area to the wake vortex danger area and marking its nulling;

a second intersection conditional test unit (30) is capable of calculating the distance from the area of the aircraft forecasted positions to the wake vortex danger area and marking its nulling;

an indication unit (31) containing at least one indication device is capable of indicating the nulling of the distance from the alert area to the generator wake vortex danger area;

an emergency indication unit (32) containing at least one indication device is capable of indicating the nulling of the distance from the area of the aircraft forecasted positions to the danger area of the generator wake vortices and the indication device is capable of indicating the nulling of the distance from the alert area to the generator wake vortex danger area and the indication device capable of indicating the nulling of the distance from the area of the aircraft forecasted positions to the danger area of the generator wake vortices are chosen from the group containing devices of visual, audio and tactile indication;

a module for simulation of noise, optical and dynamic effects; and

a module of visualization including a visualization device is capable of forming the image at least of the area of the aircraft forecasted positions and wake vortex danger areas on the basis of information received from the warning module;

wherein the image of the area of the aircraft forecasted positions is represented by a first geometric shape;

wherein the image of the wake vortex danger areas is represented by a second geometric shape;

wherein when the first and second geometric shapes intersect, a warning is issued by the warning module.

25. (Previously Presented): The simulator as claimed in claim 24, wherein the unit (23) for selection of the delay time can perform the current correction of the delay time in a manual or semiautomatic or automatic mode, the unit (27) is developed with a possibility of performing the current correction of the coordinates of the alert area and area of the aircraft forecasted positions in a manual or semiautomatic or automatic mode, the unit (22) for determination of the danger area parameters could be designed with a possibility of approximating the boundaries of the vortex generator wake vortex danger area.

26. (Previously Presented): The simulator as claimed in claim 24, wherein the aircraft admissible roll moment induced by wake vortices is chosen as the hazard criterion.

27. (Previously Presented): The simulator as claimed in claim 24, wherein the admissible value of the aircraft roll angle is chosen as the hazard criterion.

28. (Previously Presented): The simulator as claimed in claim 24, wherein it is implemented in software of the simulator modules of the operation of the simulator's modules and the module (7) for simulation of the danger area parameters comprises the database of characteristics of wake vortex danger areas for different types of vortex generators.

29. (Previously Presented): The simulator as claimed in claim 24, wherein the system (12) for estimation of the pilot actions comprises a memory device for saving information on the coordinates of the control plane, area of the aircraft forecasted positions and wake vortex danger

areas of vortex generators located in the aircraft vicinity at least within the time of emergency indication of the nulling event for the distance from the area of the aircraft forecasted positions to the danger area of the vortex generator wake vortices.

30. (Currently Amended): A flight simulator system for training pilots under wake vortex danger conditions, comprising:

- a module (1) for control of the simulator modes is capable of choosing a training scenario and controlling operation of a plurality of simulator modules;

- a training scenarios database module (2);

- a module (3) for commutation of the simulator modules;

- a module (4) for imitation of an outside visual situation, a visual part of the air space and a ground surface in real time;

- a module (6) for simulation of a pilot workplace;

- a module (5) for simulation of an aviation instrument panel with indication of a plurality of aircraft engine modes;

- a module (8) for simulation of a plurality of controls for a plurality of aircraft units and systems;

- a module (7) for simulation of a plurality of ambient parameters;

- a module (9) for simulation of a wake vortex situation caused by an aircraft is capable of determining a vortex generator wake vortex path as a set of the vorticity region centers and intensity on the basis of information from the training scenarios database module (2) and information from the module (7) for simulation of the ambient parameters;

a module (10) for simulation of wake vortex perturbation effects on the aircraft is capable of evaluation of [[any]] aircraft additional forces and moments induced by the vortex generator wake vortices on the basis of information on the wake vortex path and intensity received from the module (9) for simulation of the wake vortex situation, information on the aircraft parameters received from the training scenarios database module (2), and information on aircraft position, flight velocity, angular rates, and geometrical characteristics received from a module (11) for simulation of the aircraft dynamics;

wherein the module (11) for simulation of the aircraft dynamics is capable of forming signals imitating the aircraft forces and moments according to the training scenario, as well as additional forces and moments induced by the vortex generator wake vortices, and transmitting the signals to the module (6) for simulation of the pilot workplace, module (5) for simulation of the aviation instrument panel, and module (4) for imitation of outside visual situation on the basis of information from the module (10) for simulation of wake vortex perturbation effects on the aircraft, from the training scenarios database module (2), and from the module (8) for simulation of the controls for the aircraft units and systems;

a system for evaluation of the pilot actions is capable of estimating correctness of the pilot actions against the flight situation hazardous for the aircraft on the basis of information received from the module (4) for imitation of outside visual situation and the module (5) for simulation of the instrument panel;

a unit (13) for simulation of vortex generator dynamics including a vortex generator tracker is capable of receiving information on the vortex generator position, motion parameters, geometrical and weight characteristics from the scenarios database module (2) and a memory unit capable of storing information on the vortex generator position and motion parameters;

a unit (14) for simulation of wake vortices including a wake vortex tracker is capable of determining a vortex generator wake vortex path in the form of a set of the vorticity region center trajectories and intensity on the basis of information from the module (7) for simulation of the ambient parameters and module (13) for simulation of vortex generator dynamics, and also is capable of saving the information on coordinates of points of the vortex generator wake vortex path in the form of a set of the vorticity region center trajectories and intensity;

and the module (10) for simulation of wake vortex perturbation effects on the aircraft comprises:

a unit (15) for the aircraft schematization is capable of calculating a set of the aircraft geometrical characteristics necessary for calculation of the aircraft additional aerodynamic forces and moments induced by the vortex generator wake vortices on the basis of information on the aircraft type and configuration the training scenario database module (2); [[and]]

a unit (16) for determination of the above mentioned forces and moments on the basis of information on the coordinates of points of the vortex generator wake vortex path in the form of the set of the vorticity region center trajectories and intensity saved by the unit (14) for simulation of wake vortices and of information on the aircraft position, flight velocity, angular rates, and geometrical characteristics received from the module (11) for simulation of the aircraft dynamics; and

a module of visualization including a visualization device is capable of forming the image at least of the area of the aircraft forecasted positions and wake vortex danger areas on the basis of information received from a warning module;

wherein the image of the area of the aircraft forecasted positions is represented by a first geometric shape;

wherein the image of the wake vortex danger areas is represented by a second geometric shape;

wherein when the first and second geometric shapes intersect, a warning is issued by the warning module.

31. (Currently Amended): A flight simulator system for training pilots under wake vortex danger conditions, comprising:

a module (1) for control of the simulator modes is capable of choosing a training scenario and controlling operation of a plurality of simulator modules;

a training scenarios database module (2);

a module (3) for commutation of the simulator modules;

a module (4) for imitation of an outside visual situation, a visual part of the air space and a ground surface in real time;

a module (6) for simulation of a pilot workplace;

a module (5) for simulation of an aviation instrument panel with an indication of a plurality of aircraft engine modes;

a module (8) for simulation of a plurality of controls for a plurality of aircraft units and systems;

a module (7) for simulation of a plurality of ambient parameters;

a module (9) for simulation of a wake vortex situation caused by an aircraft is capable of determining a vortex generator wake vortex path as a set of the vorticity region centers and intensity on the basis of information from the training scenarios database module (2) and information from the module (7) for simulation of the ambient parameters;

a module (10) for simulation of wake vortex perturbation effects on the aircraft is capable of evaluation of [[any]] aircraft additional forces and moments induced by the vortex generator wake vortices on the basis of information on the wake vortex path and intensity received from the module (9) for simulation of the wake vortex situation, information on the aircraft parameters received from the training scenarios database module (2), and information on aircraft position, flight velocity, angular rates, and geometrical characteristics received from a module (11) for simulation of the aircraft dynamics;

wherein the module (11) for simulation of the aircraft dynamics is capable of forming signals imitating the aircraft forces and moments according to the training scenario, as well as additional forces and moments induced by the vortex generator wake vortices, and transmitting the signals to the module (6) for simulation of the pilot workplace, module (5) for simulation of the aviation instrument panel, and module (4) for imitation of outside visual situation on the basis of information from the module (10) for simulation of wake vortex perturbation effects on the aircraft, from the training scenarios database module (2), and from the module (8) for simulation of the controls for the aircraft units and systems; and

a system for evaluation of the pilot actions is capable of estimating correctness of the pilot actions against the flight situation hazardous for the aircraft on the basis of information received from the module (4) for imitation of outside visual situation and the module (5) for simulation of the instrument panel; [[and]]

a system (12) for estimation of the pilot actions comprises a memory device for saving information on the coordinates of the control plane, area of the aircraft forecasted positions and wake vortex danger areas of vortex generators located in the aircraft vicinity at least within the

time of emergency indication of [[the]] a nulling event for the distance from the area of the aircraft forecasted positions to the danger area of the vortex generator wake;

a module of visualization including a visualization device is capable of forming the image at least of the area of the aircraft forecasted positions and wake vortex danger areas on the basis of information received from a warning module;

wherein the image of the area of the aircraft forecasted positions is represented by a first geometric shape;

wherein the image of the wake vortex danger areas is represented by a second geometric shape;

wherein when the first and second geometric shapes intersect, a warning is issued by the warning module.

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